1600

High - Low limiter

FM APPROVED

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❒ USER'S MANUAL

0037 - 75331

APPROVALS This instrument is U.L. and c.U.L. approved as controller.

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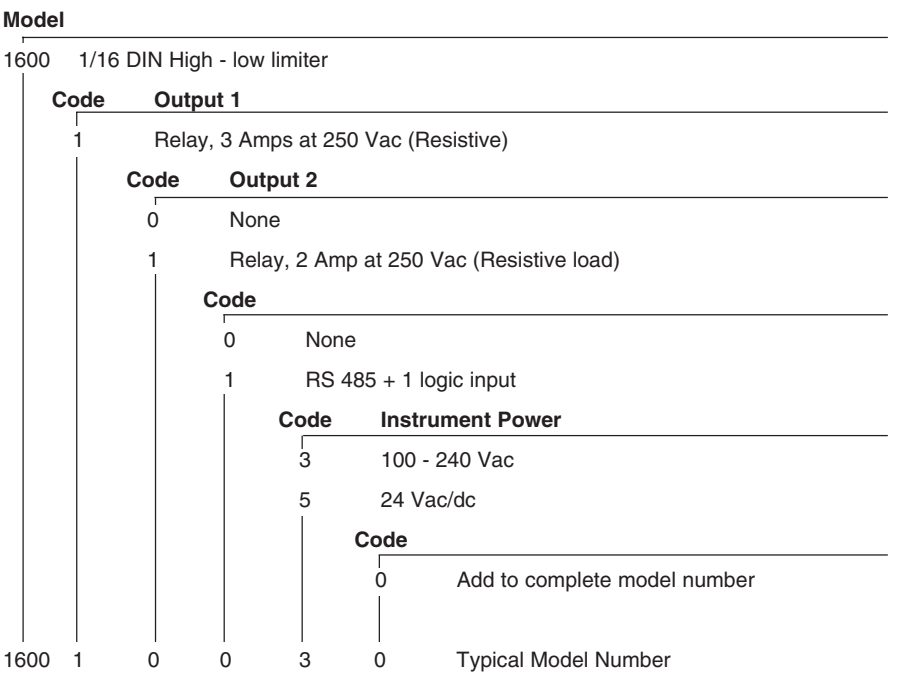
Model identification


Model
1600 1/16 DIN High - low limiter
Code Output 1
1 Relay, 3 Amps at 250 Vac (Resistive)
Code Output 2
0 None
1 Relay, 2 Amp at 250 Vac (Resistive load)
Code
0 None
1 RS 485 + 1 logic input
Code Instrument Power
3 100 - 240 Vac
5 24 Vac/dc
Code
0 Add to complete model number
1600 1 0 0 3 0 Typical Model Number

MOUNTING REQUIREMENTS

Select a mounting location with the following characteristics:

1) Minimal vibration.
2) An ambient temperature range between 0 and 50°C (32 and 122 °F).
3) Easy access to the rear of the instrument.
4) No corrosive gases (sulfuric gas, ammonia, etc.).
5) No water or other fluid (i.e. condensation).
6) Relative humidity of 20% to 80% non condensing.

The instrument can be mounted on a panel up to 15 mm (0.591 in) thick with a square cutout of 45 x 45 mm (1.772 x 1.772 in). For outline refer to Dimensions and Panel Cutout.

Panel surface texture must be better than 6.3 µm.

The instrument is shipped with a rubber panel gasket (50 to 60 Sh). To insure the IP65 and NEMA 4 protection, insert the panel gasket between the instrument and the panel as shown below.

Install the instrument as follows:

1) Insert the instrument in the gasket.
2) Insert the instrument in the panel cutout.
3) Pushing the instrument against the panel, insert the mounting bracket.
4) Torque the mounting bracket screws between 0.3 and 0.4 Nm (2.66 and 3.54 lbf-in).
5) To insure NEMA 4X/IP65 protection, make sure the instrument does not move within the cutout .

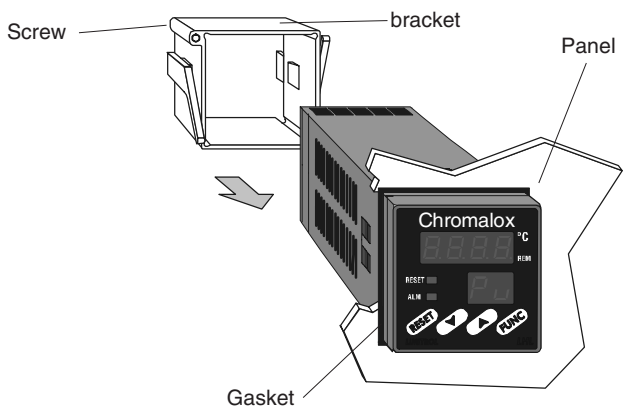
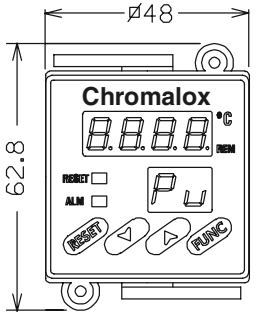
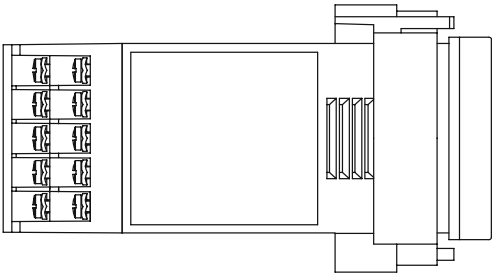


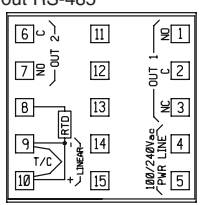
Fig. 1

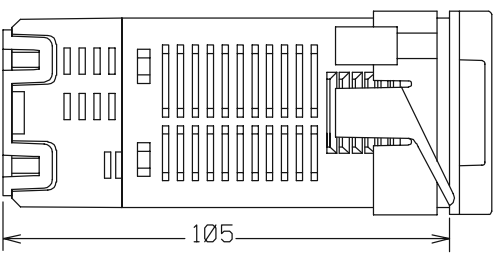
DIMENSIONS AND REAR TERMINAL BLOCKS



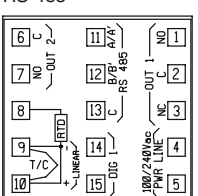


Without RS-485





With RS-485



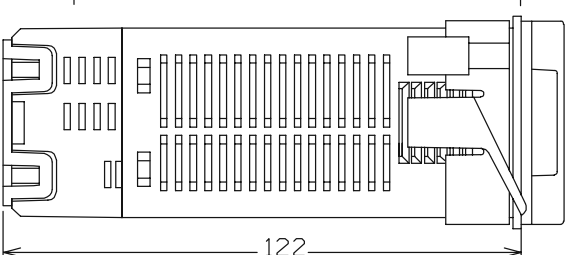


Fig.2

PANEL CUTOUT

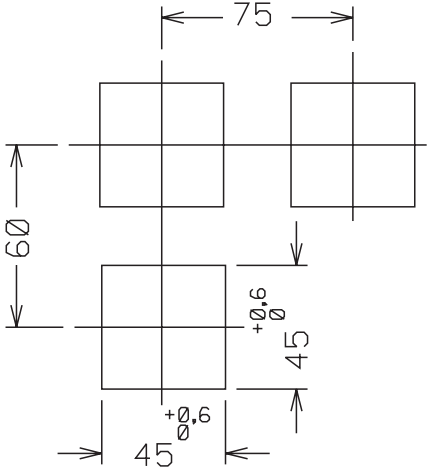


Fig.3

WIRING GUIDELINES

A) Measuring Inputs

NOTE: Any external components (like Zener diodes, etc.) connected between sensor and input terminals may cause errors in measurement due to excessive and/or not balanced line resistance or possible leakage currents.

TC Input

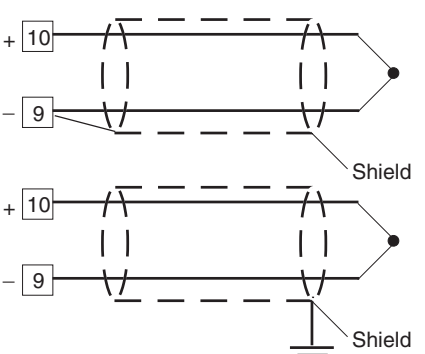


Fig. 4 THERMOCOUPLE INPUT WIRING

NOTE:
1) Do not run input wires with power cables.
2) For TC wiring use proper compensating cable, preferably shielded (see Appendix B).
3) Shielded cable should be grounded at one end only.

RTD INPUT

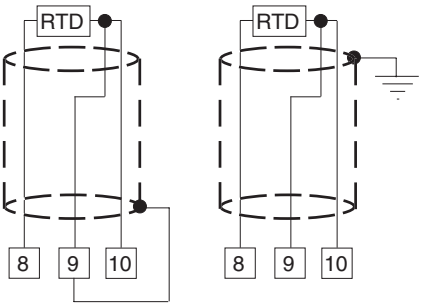


Fig. 5 RTD INPUT WIRING

NOTE:
1) Don't run input wires together with power cables.
2) Pay attention to the line resistance; a high line resistance may cause measurement errors.
3) When shielded cable is used, it should be grounded at one side only to avoid ground loop currents.
4) The resistance of the 3 wires must be the same.

LINEAR INPUT

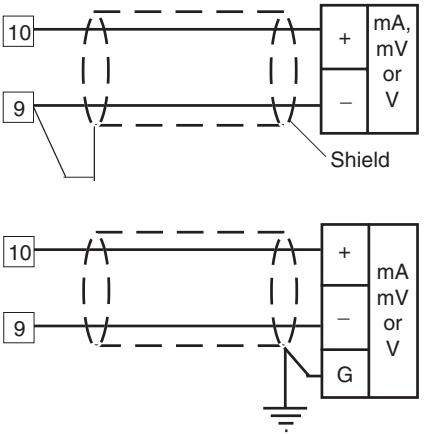


Fig. 6 mA, mV AND V INPUTS WIRING

NOTE:
1) Don't run input wires together with power cables.
2) Pay attention to the line resistance; a high line resistance may cause measurement errors.
3) When shielded cable is used, it should be grounded at one side only to avoid ground loop currents.
4) The input impedance is equal to:
   Less than 5 Ω for 20 mAdc input
   Greater than 1 MΩ for 60 mVdc input
   Greater than 400 KΩ for 5 Vdc and 10 Vdc input

B) Logic Input (for models with RS-485 only)

This input is used for remote acknowledgement (reset).

Safety note:
- Do not run logic input wiring with AC power cables.
- Use an external dry contact capable of switching 0.5 mA, 5 Vdc.
- The instrument needs 100 ms to recognize a contact status variation.
- The logic inputs are **NOT** isolated from the measuring input.

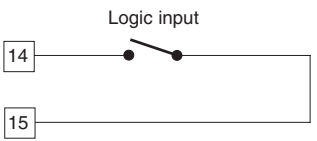


Fig.7

C.1) Relay Outputs

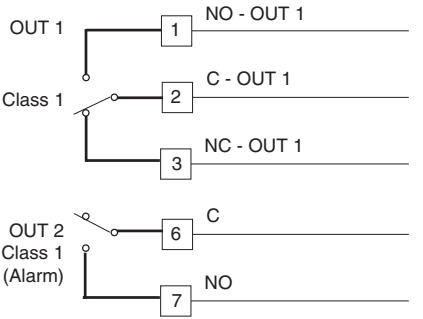


Fig. 8

The OUT 1 contact rating is 3A/250V AC on resistive load.
The OUT 2 contact rating is 2A/250V AC on resistive load.
The number of operations is 1 x 10^5 at specified rating.

NOTES
1) To avoid electric shock, connect power line at the end of the wiring procedure.
2) For power connections use No 16 AWG or larger wires rated for at last 75 °C.
3) Use cupper conductors only.
4) Don't run input wires with power cables.

All relay contacts are protected by varistor against inductive load with inductive component up to 0.5 A.

The following recommendations avoid serious problems which may occur, when relay outputs are used with inductive loads.

C.2) Inductive Loads

High voltage transients may occur switching inductive loads.
Through the internal contacts these transients may introduce disturbances which can affect the performance of the instrument.
For all the outputs, the internal protection (varistor) assures a correct protection up to 0.5 A of inductive component.

The same problem may occurs when a switch is used in series with the internal contacts as shown in Fig. 9.

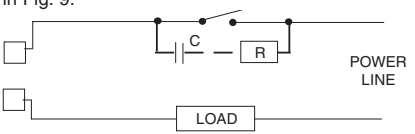


Fig. 9 EXTERNAL SWITCH IN SERIES WITH THE INTERNAL CONTACT

In this case it is recommended to install an additional RC network across the external contact as show in Fig. 9
The value of capacitor (C) and resistor (R) are shown in the following table.

LOAD (mA)	C (μF)	R (Ω)	P. (W)	OPERATING VOLTAGE
<40 mA	0.047	100	1/2	260 V AC
<150 mA	0.1	22	2	260 V AC
<0.5 A	0.33	47	2	260 V AC

The cable involved in relay output wiring must be as far away as possible from input or communication cables.

D) Serial Interface

For units built with optional RS-485 communication interface.
RS-485 interface allows to connect up to 30 devices with one remote master unit.

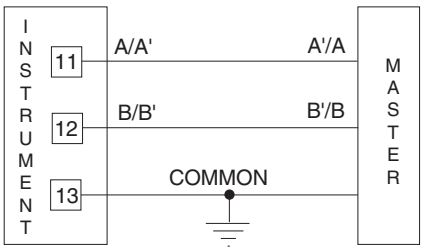


Fig. 10 - RS-485 WIRING

The cable length must not exceed 1.5 km at 9600 BAUD.

NOTES:

1) This RS 485 serial interface is insulated.
2) The following report describes the signal sense of the voltage appearing across the interconnection cable as defined by EIA for RS-485.
   a) The " A " terminal of the generator shall be negative with respect to the " B " terminal for a binary 1 (MARK or OFF) state.
   b) The " A " terminal of the generator shall be positive with respect to the " B " terminal for a binary 0 (SPACE or ON).

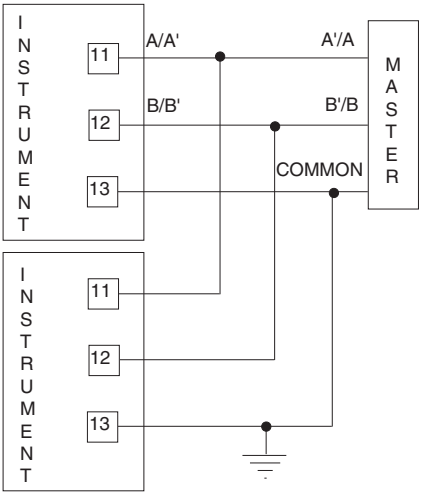


Fig.11

E) Power Line and grounding

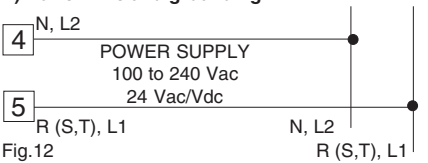


Fig.12

NOTES:

1) Before connecting the power line, check that the voltage is correct (see Model Number).
2) For supply connections use 16 AWG or larger wires rated for at least 75 °C.
3) Use copper conductors only.
4) Do not run input wires with power cables.
5) Polarity does not matter for 24 Vdc wiring.
6) The power supply input is **NOT** fuse protected. Please provide it externally.

Power supply	Type	Current	Voltage
24 V AC/DC	T	500 mA	250 V
100/240 V AC	T	125 mA	250 V

When fuse is damaged, it is advisable to verify the power supply circuit, so that it is necessary to send back the instrument to your supplier.

7) Safety requirements for permanently connected equipment:
   - Include a switch or circuit-breaker in the installation.
   - Place the switch in close proximity to the equipment and within easy reach of the operator.
   - Mark the switch as the disconnecting device for the equipment.

   NOTE: A single switch or circuit-breaker can drive more than one instrument.
8) When the NEUTRAL line is present, connect it to terminal 4.
9) To avoid shock and possible instrument damage, connect power last.

PRELIMINARY HARDWARE SETTINGS

1) Remove the instrument from its case.
2) Set J106 according to the desired input type as shown in the following figure.

INPUT	J106			
TYPE	1-2	3-4	5-6	7-8
TC-RTD	close	open	open	open
60 mV	close	open	open	open
5 V	open	close	open	open
10 V	open	open	close	open
20 mA	open	open	open	close

1600 without RS-485

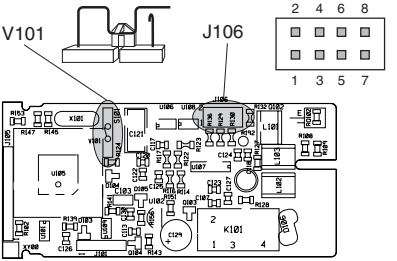


Fig.13.B

1600 with RS-485

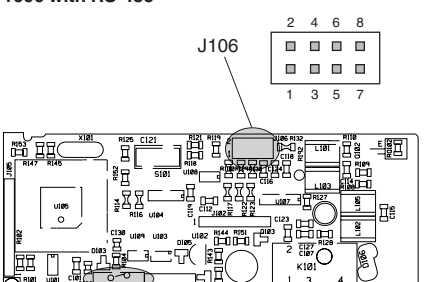


Fig.13.A

CONFIGURATION PROCEDURE

CONFIGURATION KEY FUNCTIONS

RESET In Configuration Mode, it is used only to scroll back parameters without to memorize a new parameter value.

▼ Used in Configuration Mode to decrease the parameter value.

▲ Used in Configuration Mode to increase the parameter value.

FUNC Used to memorize the new parameter value and go to the next parameter.

▼ + ▲ Loads the default parameters.

▲ + FUNC or ▼ + FUNC
Increases/decreases values at a higher rate when modifying parameters.

▲ + RESET or ▼ + RESET
Jumps to the Maximum or Minimum parameter value when modifying parameters.

CONFIGURATION PROCEDURE

1) Remove the instrument from its case.
2) Open switch V101 (See illustrations under "Preliminary Hardware Settings.")
3) Re-insert the instrument in its case.
4) Switch on power to the instrument.
   The upper display will show COnF.
   NOTE : If "CAL" indication is displayed, press immediately the ▲ pushbutton and return to the configuration procedure.
5) Press the "▼" key and the lower display will show the firmware version.

Press the "FUNC" key to start the configuration procedure with the first parameter (L1).

The following is a complete list of parameters. The lower display will show the parameter code (L1 to d1) and the upper display will show the selection code or numerical value. No timeout is applied in the configuration mode.

L1 = Serial Interface Protocol
(Skipped if option is not available.)
OFF = No serial interface
nbUS= Modbus
jbUS = Jbus

L2 = Serial Link Device Address
(Skipped if option is not available or L1 = OFF)
From 1 to 255
NOTE: EIA standard allows no more than 31 device connected by one RS-485.

L3 = Baud Rate for Serial Link
(Skipped if option is not available or L1 = OFF)
Set value from 600 to 19200 baud.
(19200 baud is shown on display as 1920)

L4 = Byte Format for Serial Link
(Skipped if option is not available or L1 = OFF)
8E = 8 bits + even parity
8O = 8 bits + odd parity
8 = 8 bits without parity

r1 =Input Type and Range Value

0 =	TC J	From	-100	to	1000	°C
1 =	TC K	From	-100	to	1370	°C
2 =	TC T	From	-200	to	400	°C
3 =	TC E	From	-100	to	800	°C
4 =	TC N	From	-100	to	1400	°C
5 =	TC S	From	-50	to	1760	°C
6 =	TC R	From	-50	to	1760	°C
7 =	TC B	From	0	to	1820	°C
8 =	TC L	From	-100	to	900	°C
9 =	TC U	From	-200	to	600	°C
10 =	TC G	From	0	to	2300	°C
11 =	TC D	From	0	to	2300	°C
12 =	TC C	From	0	to	2300	°C
13 =	TC Plat. II	From	-100	to	1400	°C
14 =	RTD Pt 100	From	-200	to	850	°C
15 =	Linear	From	0	to	60	mV
16 =	Linear	From	12	to	60	mV
17 =	Linear	From	0	to	20	mA
18 =	Linear	From	4	to	20	mA
19 =	Linear	From	0	to	5	V
20 =	Linear	From	1	to	5	V
21 =	Linear	From	0	to	10	V
22 =	Linear	From	2	to	10	V
23 =	TC J	From	-150	to	1830	°F
24 =	TC K	From	-150	to	2500	°F
25 =	TC T	From	-330	to	750	°F
26 =	TC E	From	-150	to	1470	°F
27 =	TC N	From	-150	to	2550	°F
28 =	TC S	From	-60	to	3200	°F
29 =	TC R	From	-60	to	3200	°F
30 =	TC B	From	32	to	3300	°F
31 =	TC L	From	-150	to	1650	°F
32 =	TC U	From	-330	to	1110	°F
33 =	TC G	From	0	to	4170	°F
34 =	TC D	From	0	to	4170	°F
35 =	TC C	From	0	to	4170	°F
36 =	TC Plat. II	From	-150	to	2550	°F
37 =	RTD Pt100	From	-330	to	1560	°F

r2 = Decimal Point Position
(Available only for linear range r1 = 15 to 22)

_ _ _ _ . = No decimal
_ _ _ . _ = One decimal figure
_ _ . _ _ = Two decimal figures
_ . _ _ _ = Three decimal figures

r3 = Initial value of the readout scale
(Available only for linear range r1 = 15 to 22)
Range: From -1999 to 9999

r4 = final value of the readout scale
(Available only for linear range r1 = 15 to 22)
Range: From -1999 to 9999

r5 = Offset Adjustment
Range: From -500 to 500
Offset value algebraically added to the measured value.

r6 = Time constant of the filter applied to the displayed value
Range: From 0 (filter OFF) to 8 seconds.
(First order filter with selected time constant.)

r7 = Alarm action on input fault.
When the instrument detects an input failure condition, the alarm will operate as in presence of:
uP = as in presence of the full scale value.
doun = as in presence of the initial scale value.

C1 = Type of limit action
Hi. = High limit (for heating process)
Lo. = Low limit (for cooling process)
Hi.Lo = High and low limit (for special process)

C2 = Rearming Mode
O = Acknowledgements rearm (reset) the limiter (and restart the process) only if the condition which generated the shutdown status no longer exists (points A and C of the Example 1). It do **not** generate any effect if the condition which generated the shutdown status still exists (point B of the Example 1).
I = Acknowledgements enable the automatic rearmament (reset) of the limiter if the condition which generated the shutdown status still exists (point B of the Example 2). (The instrument rearms (reset) automatically when the condition which generated the shutdown status no longer exists).

Notes about limiter function
The relay of the output 1 operates in fail-safe mode (relay de-energized during shutdown condition) and latching mode.

The OUT 1 turns OFF when:
- C1 = Hi and the measured value is greater than limiter threshold [“Su” parameter (see Operative parameters”)] or
- C1 = LO and the measured value is less than limiter threshold [“Su” parameter (see Operative parameters”)] or
- C1 = HiLO and the measured value is greater than “Su” parameter (see Operative parameters”) or less than “S1” parameter (see Operative parameters”).

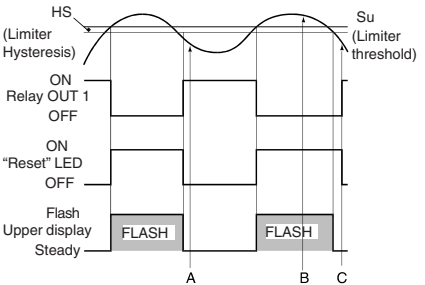
The Out 1 remains OFF until the condition which generated the shutdown, no longer exists and the acknowledge action has been performed.

The upper display flashes during a shutdown and returns to a steady display when the shutdown condition no longer exists.
When C2 = 0 and OUT 1 is OFF, the RESET LED is ON.
When C2 = 1 one of the following condition may occur:
- if no acknowledgement has been made, OUT 1 is OFF and the RESET LED is flashing;
- if the acknowledgement has been made but the condition which generated the shutdown status still exists, OUT 1 is OFF and the RESET LED is steady ON.

The shutdown condition can be stored in permanent memory (see C4).
Acknowledgment can be performed by pressing the RESET key, by momentarily closing the external dry contact or by a command from the serial link.

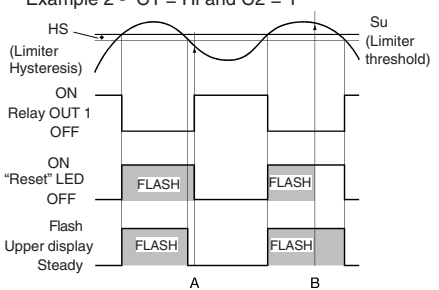
The length of the shutdown condition and max/min measured values are stored in memory and available for viewing until the next shutdown condition occurs.
These informations are lost at power down.
During a shutdown condition the max/min measured values are continuously updated and can be monitored.

Example 1 - C1 = Hi and C2 = O



A, B, C = Acknowledgment actions.
NOTE: Acknowledgment B has no effect.

Example 2 - C1 = Hi and C2 = 1



A, B = Acknowledgment actions.

C3 = Rearm at Power-up
Auto = Automatic rearm
n̄An = Manual rearm

C4 = Shutdown memory
0 = The shutdown condition will be saved (at next power up it will be reactivated)
1 = The shutdown condition will be lost in case of power down

C5 = Time Constant of the Filter applied to the Measured Value for Limit Action.
Range: From 0 (filter OFF) to 8 seconds
Note: First order filter with selected time Constant.

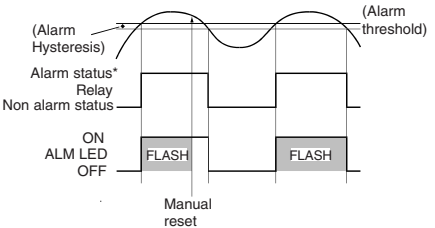
P1 = Alarm Function
(Skipped when the option is not available)
nonE = Not provided
AL.P = Process alarm
AL.b = Band alarm
AL.d = Deviation alarm
When C1 = Hi.Lo, "AL.b" and "AL.d" are not available.

P2 = Alarm configuration
(Skipped if option is not available or P1 = none)
H.A. = High alarm with automatic reset
L.A. = Low alarm with automatic reset
H.A.Ac = High alarm with automatic reset and "Silence" function.
L.A.Ac = Low alarm with automatic reset and "Silence" function.
H.L. = High alarm with manual reset
L.L. = Low alarm with manual reset

NOTE:

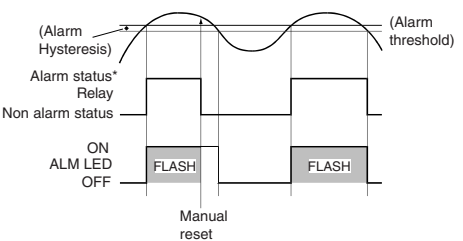
1) For band alarm, H.A./H.A.Ac/H.L. signifies outside band alarm, while L.A./ L.A.Ac/L.L. signifies inside band alarm.
2) The "Silence" function allows the manual reset of the alarm even if the alarm condition is still in progress.

Example for P2 = H.A.



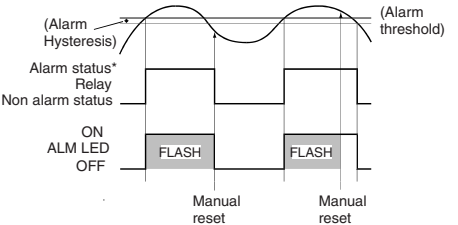
* Alarm Status: Relay energized (P3 = dir)
Relay de-energized (P3 =rEV)

Example for P2 = H.A.A.c



* Alarm Status: Relay energized (P3 = dir)
Relay de-energized (P3 =rEV)

Example for P2 = H.L.



* Alarm Status: Relay energized (P3 = dir)
Relay de-energized (P3 =rEV)

P3 = Alarm Action

(Skipped if option not is available or P1 = none)

dir = Direct action
(Relay energized in alarm condition)

rEV = Reverse action
(Relay energized in non-alarm condition)

P4 = Alarm Standby (mask) Function
(Skipped if option is not available or P1= none)
OFF = Standby function disabled
On = Standby function enabled

If the alarm is programmed as band or deviation, this function masks the alarm condition at start up and after a “Su” (limit threshold) changement until the process variable reaches the alarm threshold, plus or minus hysteresis. This standby function masks a Process Alarm condition at start up until the process variable reaches the alarm threshold plus or minus hysteresis.

PF = Time Constant of the Filter applied to the Measured Value for Alarm Action
(Skipped if option is not available or P1 = none)
Range: From 0 (filter OFF) to 8 seconds
(First order filter with selected time constant.)

n 1 = Safety Lock
0 = UNLOCKed. The device is always UNLOCKed and all parameters can be modified.
l = LOCKed. The device is always LOCKed and no parameters can be modified
From 2 to 9999 = This number is a password, to be used in run time (see “nn”), to LOCK/ UNLOCK the device.

t1 = Timeout Selection
tn10 = 10 second timeout
tn30 = 30 second timeout

d1 = Digital Input (contact closure)
(This is a read only parameter)
Enb = Digital input enabled
dIS = Digital input disabled
(The digital input is used as a remote Acknowledgment .)

The configuration procedure is now completed.
The display will show "COnF".

OPERATING MODE

1) Remove the instrument from its case.
2) Set switch V101 (see fig. 13) to the closed position.
3) Re-insert the instrument in its case.
4) Switch on the instrument.

Normal Display Mode

On powerup the device starts in the "Normal Display Mode."

By pressing the ▲ or ▼ key, it is possible to change the displayed information; therefore, one of the following display modes can be selected:

1) The upper display shows the measured value while the lower display shows the "Pu" (Process variable).
   If this display was active at power down, it will be active at powerup.
2) The upper display shows the limiter threshold while the lower display shows "Su." If this display was active at power down, it will be active at powerup.
3) The upper display shows the second limiter threshold while the lower display shows "S1." This information is available only if C1 = Hi.Lo. If this display was active at power down, it will be active at powerup.
4) The upper display shows the total time (hh.mm) of the last shutdown condition while the lower displays shows “t.” If no shutdown condition was detected, the upper display will show “- - - -”. The information is lost at power down and at powerup the device will display the process variable.
5) The upper display shows the maximum measured value detected during the last shutdown condition while the lower display shows "Ph.". If no shutdown condition was detected, the upper display will show “- - - -”. This information is not available if C1 = HI.Lo. The information is lost at power down and at powerup the device will display the process variable.

NOTE: When the shutdown condition was generated by an input fault condition, the upper display will indicate "m̄.Err"

6) The upper display shows the minimum mesured value detected during the last shutdown condition while the lower display shows "PL." If no shutdown condition was detected, the upper display will show “- - - -”. This information is not available if C1 = Hi. The information is lost at power down and at powerup the device will display the process variable.

   NOTE: When the shutdown condition was generated by an input fault condition, the upper display will indicate "m̄.Err"

If, at power off, the device was in shutdown condition and shutdown memoy function is selected (C4 = 0), and/or it was programmed for manual reset at startup (C3 = 1), then at the next power up the lower display will be flashing.

Indicators

"RESET" = Indicates control output 1 status as follows:
- a) When C2 parameter has been configured equal to 0,
  LED ON when Output 1 is OFF
  LED OFF when Output 1 is ON
- b) When C2 parameter has been configured equal to 1,
  LED flashes when Output 1 is OFF
  LED ON when Output 1 is OFF and acknowledged
  LED OFF when Output is ON

"ALM" = Indicates alarm status as follows:
- Flashes when alarm is ON
- ON when alarm has been resetted but the alarm condition is still present.
- OFF when alarm is OFF

"REM" = Indicates the remote status of the instrument.
- Flashes when instrument is in remote mode.
- OFF when instrument is in local mode.

Key Functions in Normal Display Mode

"FUNC" = By pressing it, the display changes from "Normal Display Mode" to "Operative Parameter Display Mode."

= Pressing it for more than ten seconds initiates the Lamp Test. During the Lamp Test the device function normally while all display segments and LED's are lit with a 50% duty cycle. No timeout is applied to a lamp test.
Press the "FUNC" key again to end the Lamp Test.

"▲" or "▼" = By pressing these keys it is possible to change the displayed information. See "Normal Display Mode" on previous page.

"RESET" = Press and hold for 1 second to rearm (reset) the limiter.

▲ + FUNC or ▼ + FUNC
Increases/decreases values at a higher rate when modifying parameters.

▲ + RESET or ▼ + RESET
Jumps to the Maximum or Minimum parameter value when modifying parameters.

Operative Parameter Display Mode

The "FUNC" key initiates the Operative Parameter Display Mode when pressed for less than 10 seconds in the "Normal Display Mode."

The lower display shows the parameter code while the upper display shows the parameter value or status. The value of the selected parameter can be modified with the ▲ and ▼ keys.

Press the "FUNC" key again to store the new value and advance to the next parameter.

If no keys are pressed within the timeout period (see t1), the instrument will automatically return to the "Normal Display Mode" in the previous display and any modification of the last displayed parameter will be lost.

All parameters (except rR) can be modified only when the device is UNLOCKed.

The LOCK/UNLOCK status can be selected in configuration using "n1" parameter or during the operating mode with the "nn" parameter (password).

To switch from LOCKED to UNLOCKED, assign to the “nn” parameter a value equal to the “n1” parameter setting. To switch from UNLOCKED to LOCKED, assign to the “nn” parameter any number other than the n1 parameter setting.
When the device is in remote mode (the serial link controls the device) no parameters can be modified.

Key Functions in
Operative Parameter Display Mode

FUNC	=	Pressing the “FUNC” key, the instrument stores the new setting (if changed) and goes to the next parameter.
▲ or ▼	=	Changes the setting of the selected parameter.
RESET	=	Press and hold for more than 1 second for limiter rearmament.

OPERATING PARAMETERS
Some of the following parameters may not appear, depending on the configuration.

Lower Display — Description

AR — **Manual reset of the alarm.**
(Available only if P1 = AL.p, AL.b or AL.d)
ON = Starts the manual reset of the alarm
OFF = Do not start the alarm reset.
Select ON and press the FUNC key in order to reset the alarm.
After a manual reset of the alarm the instrument returns in Normal Display Mode.

nn — **Software Key**
(Skipped if n1 = 0 or 1)
ON = the device is LOCKED.
OFF = the device is UNLOCKED.
When it is desired to switch from LOCK to UNLOCK condition, set a value equal to “n1” parameter.
When it is desired to switch from UNLOCK to LOCK condition, set a value different from “n1” parameter.

Su — **Limiter Threshold**
Range: Span limits (From "S1" to full scale value when C1 = Hi.Lo)

S1 — **Second Limiter Threshold**
(Available when C1 = Hi.Lo)
Range: From initial scale value to "Su"

HS — **Limiter Hysteresis**
Range: From 0.1% to 10.0% of the input span or 1 LSD

AL — **Alarm Threshold (optional)**
(Available only if the option is fitted and P1= AL.P, AL.b or AL.d.)
Ranges:
span limits for process alarm (P1 = AL.P)
from 0 to 500 for band alarm (P1 = AL.b)
from -500 to 500 for deviation alarm (P1 = AL.d)

HA — **Alarm Hysteresis (optional)**
(Available only if the option is fitted and P1 = AL.P, AL.b or AL.d)
Range: From 0.1% to 10.0% of the input span or 1 LSD.

Limiter function
The relay of the output 1 operates in fail-safe mode (relay de-energized during shutdown condition) and latching mode.

The OUT 1 turns OFF when:
- The instrument is configured as a high limiter (C1 = Hi) and the measured value is greater than limiter threshold [“Su” parameter (see Operative parameters”)] or
- The instrument is configured as a low limiter (C1 = LO) and the measured value is less than limiter threshold [“Su” parameter (see Operative parameters”)] or
- The instrument is configured as a high/low limiter (C1 = HiLO) and the measured value is greater than “Su” parameter (see Operative parameters”) or less than “S1” parameter (see Operative parameters”).

The Out 1 remains OFF until the condition which generated the shutdown, no longer exists and the acknowledge action has been performed.

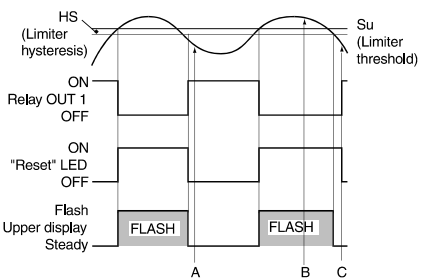
The upper display flashes during a shutdown and returns to a steady display when the shutdown condition no longer exists.

When the OUT 1 is OFF the RESET LED is ON [if the selected rearming mode is equal to 0 (C2 = 0)] or flashes [if the selected rearming mode is equal to 1 (C2 = 1)].
When the selected rearming mode is equal to 1 (C2 = 1) the RESET LED is steady ON when OUT 1 is OFF and acknowledged.
The shutdown condition can be stored in permanent memory (see C4).
Acknowledgment can be performed by pressing the RESET key, by momentarily closing the external dry contact or by a command from the serial link.

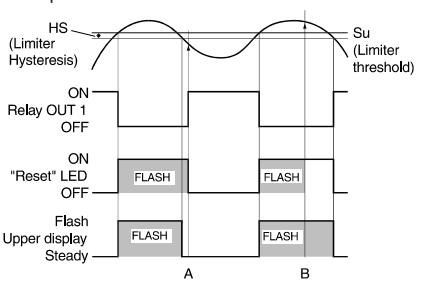
The length of the shutdown condition and max/min measured values are stored in memory and available for viewing (see “Normal Display Mode”) until the next shutdown condition occurs.
These informations are lost at power down.

During a shutdown condition the max/min measured values are continuously updated and can be monitored.

Example 1 - C1 = Hi and C2 = O



Example 2 - C1 = Hi and C2 = 1



Alarm functions
(Skipped if option is not available or P1 = none)
The alarm can be programmed as:
- process alarm
- band alarm
- deviation alarm.

Band and deviation alarms are referred to the limiter threshold and are possible only if an high limiter or a low limiter function has been selected.
For all the alarm types, it is possible to select automatic or manual reset or the “Silence” function.
The "Silence" function is a typical function of the alarm annunciators (see ISA “Alarm annunciator operational sequence”) and it is usually applied to audible alarm indications (horn). This function allows the manual reset of the alarm even if the alarm condition is still in progress.

It is also possible to assign to the alarm a stand by (mask) function.
If the alarm is programmed as band or deviation alarm, this function masks the alarm condition after a safety threshold change or at the instrument start-up until process variable reaches the alarm threshold plus or minus hysteresis. If the alarm is programmed as a process alarm, this function masks the alarm condition at instrument start-up until process variable reaches the alarm threshold plus or minus hysteresis.
Graphic example of the alarm behaviour are shown at pages 12 and 13.

Serial LInk (optional)
The device can be connected to a host computer via serial link.

The host can put the device in LOCAL (parameters are controlled via keyboard) or in REMOTE (functions and parameters are controlled via serial link). REMOTE is shown by the decimal point to the left of "REM" which is on the right side of the numerical display.

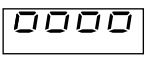
Via serial link it is possible to read and/or to modify all the operative and configuration parameters.
The following conditions must apply to implement this function:
1) Configure parameters L1 through L4 with the front keyboard.
2) The device must be in the Operating mode.

For other details require ENG 816-E document.

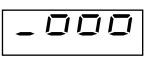
ERROR MESSAGES

Overrange, Underrange and Sensor Break Indications

This device detects input fault conditions. (OVERRANGE, UNDERRANGE OR SENSOR BREAK). When the process variable exceeds the span limits an OVERRANGE condition will appear as:



An UNDERRANGE condition will appear as:



A sensor break is signalled as "OPEn". On the mA/V input, a sensor break can be detected only when the range selected has a zero elevation (4/20 mA, 12/60 mV, 1/5 V or 2/10 V.)

On the RTD input "shrt" is signalled when input resistance is less than 15 Ω (short circuit sensor detection).

This device detects reference junction errors or errors on the internal autozero measurement. When a fault is detected the output goes OFF and the alarm assumes an upscale/downscale reading in accordance with r7.

Error Messages

On power up, the instrument performs a self-diagnostic test. When an error is detected, the lower display shows an "Er" indication while the upper display shows the code of the detected error.

Error List

100	Error in EEPROM writing
150	Short circuit on CPU's outputs
200	Error on "protect register" in EEPROM
XXX	Configuration parameter error.
301	Error on calibration of selected input.
307	rj input calibration error.
400	Error on operative parameters.
500	Error on autozero measurement.
502	Error on reference junction measurement.
510	Error during calibration procedure.

Dealing with Error Messages

1) When a configuration parameter error is detected, repeat the configuration procedure of that specific parameter.
2) If an error 400 is detected, press and hold the ▼ key and press the ▲ key and load the default parameters; then repeat the control parameter setup.
3) For all other errors, contact your Service Representative.

GENERAL SPECIFICATIONS

Case: Polycarbonate grey case

Self extinguishing degree: V-0 according to UL94.

Front protection - designed and tested for IP 65 (*) and NEMA 4X (*) for indoor locations (when panel gasket is installed).

(*) Test were performed in accordance with IEC 529, CEI 70-1 and NEMA 250-1991 STD.

Installation: panel mounting.

Rear terminal board: 15 screw terminals (screw M3, for cables from ϕ 0.25 to ϕ 2.5 mm^2 or from AWG 22 to AWG 14), connection diagram and safety rear cover.

Dimensions: 48 x 48 mm (according to DIN 43700); depth

- 122 mm for models with RS-485.
- 105 mm for models without RS-485

Weight: 250 g. max. (8.75 oz.).

Power supply : (switching mode) from 100 to 240 V AC. 50/60 Hz (+10 % to -15 % of the nominal value) or
24 V DC/AC ($\pm$10 % of the nominal value).

Power consumption: 8 VA.

Insulation resistance: > 100 MΩ according to IEC 1010-1.

Isolation voltage: 1500 V r.m.s. according to IEC 1010-1.

Common mode rejection ratio:
120 dB @ 50/60 Hz.

Normal mode rejection ratio: 60 dB @ 50/60 Hz.

Electromagnetic compatibility and safety requirements: This instrument is marked CE. Therefore, it is conforming to council directives 89/336/EEC (reference harmonized standard EN 50081-2 and EN 50082-2) and to council directives 73/23/EEC and 93/68/EEC (reference harmonized standard EN 61010-1).

Installation category: II

D/A conversion: dual slope integration.

Sampling time :

- for linear inputs = 250 ms.
- for TC or RTD inputs = 500 ms.

Display updating time: 500 ms.

Resolution: 30000 counts.

Temperature Drift (CJ excluded)

- Less than 200 ppm/°C of full span for mV and TC ranges 0, 1, 3, 4, 8, 13, 23, 24, 26, 27, 31, 36 (CJ excluded).
- Less than 300 ppm/°C of full span for mA, V and TC ranges 10, 11, 12, 33, 34, 35 (CJ excluded)
- Less than 400 ppm/°C of full span for RTD and TC range 9, 32 (CJ excluded).
- Less than 500 ppm/°C of full span for TC ranges 2, 5, 6, 25, 28, 29 (CJ excluded).
- Less than 600 ppm/°C of full span for TC ranges 7, 30.

  NOTE: Precision and drift guaranteed (for T>300°C/570°F).

Accuracy: $\pm$ 0.2% f.s.v. @ 25 °C (77 °F) and nominal power supply voltage.

Operative temperature: from 0 to +50 °C (32 to 122 °F).

Storage temperature: from -20 to +70 °C (-4 to 158 °F).

Humidity: from 20% to 85 % RH not condensing.

INPUTS

A) THERMOCOUPLE

Type : J, K, T, E, N, S, R, B, L, U, G(W), D(W3), C(W5), Platinel II, °C/°F selectable.
External resistance: 100 Ω max, maximum error 0,1% of span.
Burn out: It is shown as an overrange condition (standard). It is possible to obtain an underrange indication by cut and short.
Cold junction: automatic compensation from 0 to 50 °C.
Cold junction accuracy : 0.1 °C/°C
Input impedance: > 1 MΩ
Calibration : according to IEC 584-1 and DIN 43710 - 1977.
STANDARD RANGES TABLE

T/C type	Ranges			
J	0	-100 / 1000 °C	23	-150 / 1830 °F
K	1	-100 / 1370 °C	24	-150 / 2500 °F
T	2	-200 / 400 °C	25	-330 / 750 °F
E	3	-100 / 800 °C	26	-150 / 1470 °F
N	4	-100 / 1400 °C	27	-150 / 2550 °F
S	5	-50 / 1760 °C	28	-60 / 3200 °F
R	6	-50 / 1760 °C	29	-60 / 3200 °F
B	7	0 / 1820 °C	30	32 / 3300 °F
L	8	-100 / 900 °C	31	-150 / 1650 °F
U	9	-200 / 600 °C	32	-330 / 1110 °F
G(W)	10	0 / 2300 °C	33	0 / 4170 °F
D(W3)	11	0 / 2300 °C	34	0 / 4170 °F
C(W5)	12	0 / 2300 °C	35	0 / 4170 °F
P.(*)	13	-100 / 1400 °C	36	-150 / 2550 °F

(*) P. equal to Platinel II

B) RTD (**R**esistance **T**emperature **D**etector)
Input: for RTD Pt 100 Ω, 3 wire connection.
Input circuit: current injection.
°C/°F selection: via front pushbuttons or serial link.
Line resistance: automatic compensation up to 20 Ω/wire with no measurable error.
Calibration: according to DIN 43760
Burn out : The instrument detect the open condition of one or more wires. It is able to detect also the short circuit of the sensor.

STANDARD RANGES TABLE

Input type	Ranges		
RTD Pt 100 Ω	14	- 200 / 850	°C
DIN 43760	37	- 330 / 1560	°F

C) LINEAR INPUTS

Read-out: keyboard programmable between -1999 and +9999.
Decimal point: programmable in any position
Burn out: the instrument shows the burn out condition as an underrange condition for 4-20 mA, 1-5 V and 2-10 V input types.
It shows the burn out condition as an underrange or an overrange condition (selectable by soldering jumper) for 0-60 mV and 12-60 mV input types. No indication are available for 0-20 mA, 0-5 V and 0-10 V input types.

STANDARD RANGES TABLE

Input type		impedance	Accuracy
15	**0 - 60 mV**	> 1 MΩ	0.2 % + 1 digit @ 25°C (77 °F)
16	**12 - 60 mV**		
17	**0 - 20 mA**	< 5 Ω	
18	**4 - 20 mA**		
19	**0 - 5 V**	> 400 kΩ	
20	**1 - 5 V**		
21	**0 - 10 V**	> 400 kΩ	
22	**2 - 10 V**		

D) LOGIC INPUTS
(for models with RS-485 only)

This instrument is provided of 1 logic input used for remote acknowledgement.

NOTES

1) Use an external dry contact capable of switching 0.5 mA, 5 V DC.
2) The instrument needs 100 ms to recognize a contact status variation.
3) The logic inputs are **NOT** isolated by the measuring input.

OUTPUTS

Output updating time :
- 250 ms when a linear input is selected
- 500 ms when a TC or RTD input is selected.

OUTPUT 1
Type: relay SPDT contact .
Contact rated: 3 A at 250 V AC on resistive load.
Function: Safety limiter output.
Action: reverse (fail-safe).

OUTPUT 2
Type: relay SPST contact .
Contact rated: 2 A at 250 V AC on resistive load.
Function: Alarm output
Action: direct/reverse programmable by front keyboard.

ALARM

Action: Direct or reverse acting.
Alarm functions: configurable as process alarm, band alarm or deviation alarm.
Alarm reset: automatic reset, manual reset or "Silence" function is programmable.
Stand by (mask) alarm: the alarm can be configured with or without stand by (mask) function.

Process alarm:
Operative mode : High or low programmable.
Threshold : programmable in engineering unit within the readout span.
Hysteresis: programmable from 0.1 % to 10.0 % of the readout span.

Band alarm
Operative mode: Inside or outside band programmable.
Threshold: programmable from 0 to 500 units.
Hysteresis : programmable from 0.1 % to 10.0 % of the readout span.

Deviation alarm
Operative mode : High or low programmable.
Threshold : programmable from - 500 to +500 units.
Hysteresis : programmable from 0.1 % to 10.0 % of the readout span.

SERIAL COMMUNICATION INTERFACE (OPTION)
Type: insulated RS-485.
Protocol type: MODBUS or JBUS.
Baud rate: programmable from 600 to 19200 BAUD.
Byte format: 8 bit.
Parity: even, odd or none programmable.
Stop bit: one.
Address: from 1 to 255.
Output voltage levels: according to EIA standard.

MAINTENANCE
1) REMOVE POWER FROM THE POWER SUPPLY TERMINALS AND FROM RELAY OUTPUT TERMINALS
2) Remove the instrument from case.
3) Using a vacuum cleaner or a compressed air jet (max. 3 kg/cm^2) remove all deposit of dust and dirt which may be present on the louvers and on the internal circuits trying to be careful for not damage the electronic components.
4) To clean external plastic or rubber parts use only a cloth moistened with:
   - Ethyl Alcohol (pure or denatured) [C_2H_5OH] or
   - Isopropil Alcohol (pure or denatured) [$(CH_3)_2CHOH$] or
   - Water (H_2O)
5) Verify that there are no loose terminals.
6) Before re-inserting the instrument in its case, be sure that it is perfectly dry.
7) re-insert the instrument and turn it ON.

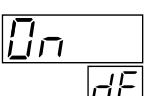
APPENDIX A
DEFAULT PARAMETERS

DEFAULT PARAMETERS

Loading Default Operating Parameters
The control parameters can be loaded with predetermined default values. These are the settings loaded into the instrument prior to shipment from the factory. To load the default values proceed as follows:

a) Press and hold the ▼ key and press the ▲ key; the displays will show:

b) Press either the ▼ or ▲ key; the display will show:



c) Press the "FUNC" key; the display will show:

This indicates that the loading procedure has been initiated. After about 3 seconds the loading procedure is complete and the instrument reverts to the “Normal Display Mode.” The following is a list of the default operating parameters loaded during the procedure:

Default Operating Parameters List

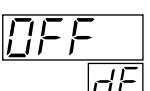
Parameter	Default Value
Alarm Acknowledge	OFF
Software Key	Unlock
Setpoint Threshold	Low range value (if low limit) High range value (if high or high/low limit)
Setpoint1 Threshold	Low range value
Setpoint Threshold Hysteresis	0.1%
Alarm Threshold	Low range (if process alarm) 100 (if deviation or band alarm)
Alarm Hysteresis	0.1%

Loading Default Configuration Parameters
The configuration parameters can be loaded with predetermined default values. These are the settings loaded into the instrument prior to shipment from the factory. To load the default values proceed as follows:

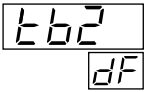
a) Internal switch V101 must be open.
b) The upper display will show:

c) Press the ▼ key; the lower display will show the firmware version.

d) Still holding the ▼ key, press the ▲ key; the display will show:



e) Press the ▲ key to select Table 1 (European) or Table 2 (American) default parameters; the display will show:



f) Press the FUNC key; the display will show:

This indicates that the loading procedure has been initiated. After about 3 seconds the procedure is complete and the instrument reverts to the “COnF” display. The following is a list of the default configuration parameters loaded during the procedure:

PARA.	Table 1	Table 2
	European	American
L1	nbUS	nbUS
L2	1	1
L3	19200	19200
L4	8E	8E
r1	Type J (-100 to 1000 °C)	Type J (-150 to 1830 °F)
r2	----.	----.
r3	-100	-150
r4	1000	1830
r5	0	0
r6	1 second	1 second
r7	uP	uP
c1	Hi	Hi
c2	1	0
c3	Auto	Auto
c4	0	0
c5	1 second	1 second
P1	nonE	nonE
P2	H.A.	H.A.Ac
P3	rEV	rEV
P4	OFF	OFF
PF	1 second	1 second
n1	0	0
t1	10 seconds	30 seconds

Appendix A.4

APPENDIX B

THERMOCOUPLE COMPENSATING CABLE COLOR CODES.

Thermocouple Material	British BS 1843	American ANSI MC 96.1	German DIN 43710	French NFE 18-001
T Copper Constantan	+ White - Blue Blue	+ Blue - Red Blue	+ Red - Brown Brown	+ Yellow - Blue Blue
J/L Iron Constantan	+ Yellow - Blue Black	+ White - Red Black	+ Red - Blue Blue	+ Yellow - Black Black
K Nickel Chromium Nickel Aluminum	+ Brown - Blue Red	+ Yellow - Red Yellow	+ Red - Green Green	+ Yellow - Purple Yellow
R Platinum/Platinum 13% Rhodium	+ White - Blue Green	+ Black - Red Green	+ Red - White White	+ White - Green Green
S Platinum/Platinum 10% Rhodium	+ White - Blue Green	+ Black - Red Green	+ Red - White White	+ White - Green Green
E Chromel Constantan	+ Brown - Blue Brown	+ Violet - Red Violet	– –	– –
B Platinum 30% Rh Platinum 6% Rh	– – –	+ Grey - Red Grey	– – –	– – –
N Nicrosil / Nisil		–	–	–

Warranty And Limitation Of Remedy And Reliability

Chromalox warrants only that the Products and parts manufactured by Chromalox, when shipped, and the work performed by Chromalox when performed, will meet all applicable specification and other specific product and work requirements (including those of performance), if any, and will be free from defects in material and workmanship under normal conditions of use. All claims for defective or non conform, (both hereinafter called defective). Products, parts or work under this warranty must be made in writing immediately upon discovery, and in any event within three (3) years from delivery, provided, however all claims for defective Products and parts must be made writing no later than three (3) years after shipment by Chromalox. Defective and nonconforming items must be held by Chromalox's inspections and returned to the original f.o.b. point upon request. THE FOREGOING IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES WHATSOEVER, EXPRESS, IMPLIED AND STATUTORY, INCLUDING, WITHOUT LIMITATION, THE IMPLIED WARRANTIES OF MERCHANT ABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

Not withstanding the provisions of this WARRANTY AND LIMITATIONS Clause it is specifically understood that Products and parts not manufactured and work not performed by Chromalox are warranted only to the extent and in the manner that the same are warranted to Chromalox by Chromalox's vendors, and then only to the extent that Chromalox is reasonably able to enforce such a warranty, it being understood Chromalox shall have no obligation to initiate litigation unless buyer undertakes to pay all cost and expenses therefore including but not limited to attorney's fees and indemnifies Chromalox against any liability to Chromalox's vendors arising out of such litigation.

Upon buyer's submission of a claim as provided above and in its substantiation, Chromalox shall at its option either (i) repair or replace its Products, parts or work at the original f.o.b. point of delivery or (ii) refund an equitable portion of the purchase price. The foregoing is Chromalox's only obligation and buyer's exclusive remedy for breach of warranty, and is buyer's exclusive remedy against Chromalox for all claims arising hereunder or relating hereto whether such claims are based on breach of contract, tort (including negligence and strict liability) or other theories, buyer's failure to submit a claim as provided above shall specifically waive all claims for damages or other relief, including but not limited to claims based on latent defects. In no event shall buyer be entitled to incidental or consequential damages and buyer should hold Chromalox harmless therefrom. Any action by buyer arising hereunder or relating hereto, whether based on breach of contract, tort (including negligence and strict liability) or other theories, must be commenced within three (3) years after the date of shipment or it shall be barred.

Returns

Items returned to Chromalox Instruments and Controls must be accompanied by a Return Authorization Number. This number may be obtained from Chromalox Instruments and Controls, Customer Service Department. Telephone Number (615)793-3900. It should appear on the exterior of the shipping carton and on the shipping documents. Defective items will be repaired or replaced at our option, at no charge.

Return the defective part or product, freight prepaid, to:
Chromalox Instruments and Controls
1382 Heil-Quaker Blvd.
LaVergne, TN 37086-3536

Chromalox®

INSTRUMENTS AND CONTROLS
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EMERSON ELECTRIC CO.